

DISTRIBUTION AND CONSERVATION STATUS OF THE TWO-SPINED BLACKFISH *GADOPSIS BISPINOSUS* IN VICTORIA

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In Victoria, the two-spined blackfish, *Gadopsis bispinosus*, is restricted to the upper reaches of streams north of the Great Dividing Range in the eastern part of the state, at altitudes of 200-760 m. The western limit of the species' range appears to be King Parrot Creek, about 50 km north-east of Melbourne; the northern and eastern parts of its range extend into New South Wales. Recent surveys and the re-examination of *Gadopsis* specimens collected before *G. bispinosus* was described in 1984 show that *G. bispinosus* is common and abundant throughout its range, with more than 2087 specimens having been recorded from 55 sites. Consequently, the conservation status of this species in Victoria is revised to the category of 'restricted', i.e. "a taxon which is not presently in danger but which occurs in a restricted area".

THE GADOPSIDAE is a family of freshwater fish endemic to south-eastern Australia and containing two species in the genus *Gadopsis*. The freshwater blackfish, *Gadopsis marmoratus* Richardson, 1848, is widespread throughout Victoria and has been the subject of much research (Jackson 1975, 1978a, 1978b, 1981, unpublished data, Jackson & Llewellyn 1980, Jackson & Williams 1980, Koehn 1986, unpublished data). The two-spined blackfish, *Gadopsis bispinosus* Sanger, was described in 1984 after a detailed study of the taxonomy of the *Gadopsis* complex (Sanger 1984, 1986). *G. bispinosus* is distinguished from *G. marmoratus* by having two (range 1-3) instead of 11 (range 6-13) dorsal fin spines and by having a prominent white fringe on the dorsal, anal and caudal fins (Sanger 1984).

The present paper records the localities in Victoria where *G. bispinosus* has been collected. An assessment of conservation status is made on the basis of the abundance of the species at many sites, its distribution, its biological requirements and possible threats.

METHODS

Information on the distribution of *G. bispinosus* was obtained from specimen collections of the Fisheries Division and the Museum of Victoria, from recent surveys conducted by Fisheries Division staff, from recent publications (Sanger 1986, Brumley et al. 1987, Morison & Anderson 1987, Anderson & Morison 1989), and from two reliable but unconfirmed reports by an angler.

The surveys were conducted at 46 sites, many of them lying outside the range of *G. bispinosus* described in this paper, but these helped to establish the species' western limit of distribution.

Of the *Gadopsis* specimens held by the Fisheries Division and the Museum of Victoria, all those which had been collected before *G. bispinosus* was described and which had been previously identified as *G. marmoratus* were re-examined.

Abundance data available from many surveys were collated and, together with distributional data, were presented for discussion at a meeting convened at the Arthur Rylah Institute for Environmental Research on 12 August 1989 for the purpose of reviewing the conservation status of Victorian native freshwater fish (Koehn & Morison 1990).

RESULTS

G. bispinosus has been recorded from 55 sites in Victoria (Fig. 1, Table 1). The specimen from site 10 was collected in 1974 prior to the filling of Lake Dartmouth, so that this population can no longer be confirmed. One specimen in the Museum of Victoria (registration no. NMV A7982, recorded as being from the "Jamicon River, Victoria", presumably the Jamieson River) was collected on 11 December 1885. The species was also recorded by Sanger (1986) from unspecified localities in the Indi River, Snowy Creek (a tributary of the Mitta Mitta River) and the Catherine River (Ovens River Basin).

Site No.	Stream	Altitude (m)	Map. No.	Grid Ref.	Date	No. Specimens	Collector
1	Nariel Ck	500	8425	743 664	7.3.78	12	AB
2	Corryong Ck	300	8425	777 963	8.3.78	12	AB
3	Cudgewa Ck	400	8425	598 909	9.3.78	12	AB
4	Cudgewa Ck	280	8425	749 028	8.3.78	12	AB
5	Koetong Ck	360	8325	355 075	25-27.1.89	22	K
6	Bucheen Ck	480	8425	491 706	7.6.79	24	AB
7	Tallangatta Ck	300	8325	375 793	7.6.79	13	AB
8	Bundarra R.	760	8324	401 050	4.3.80	21	BT
9	Big R.	720	8324	412 167	1987	1	GP
10	Mitta Mitta R.	380	8424	512 522	2.2.74	1	NMV
11	Mountain Ck	460	8324	195 377	5.6.79	1	AB
12	Kiewa R.	320	8324	140 365	6.6.79	1	AB
13	Morses Ck	320	8224	981 336	23.5.79	25	AB
14	Buckland R.	380	8224	872 215	24.5.79	5	AB
15	Buckland R.	340	8224	863 278	1.6.87	4	*
16	Buckland R.	280	8224	905 385	4.4.78	6	AB
					24.5.79	12	AB
					18.3.80	33	AB
17	Ovens R.	260	8224	908 393	1984-87	86	JK
18	Ovens R.	220	8224	825 475	5.4.78	6	AB
19	Ovens R.	220	8224	785 498	17.3.80	37	AB
20	Buffalo R.	360	8224	734 144	6.4.78	31	AB
					7.6.87	1	K
21	Buffalo R.	280	8224	696 230	13.2.89	77	K
22	Buffalo R.	280	8224	695 256	8.6.87	1	K
					16.2.89	25	K
23	Rose R.	460	8224	586 093	7.5.79	32	AB
24	Dandongadale R.	320	8224	647 232	9.5.79	24	AB
					2.4.80	39	AB
25	Dandongadale R.	300	8224	669 263	22.2.89	7	K
26	Dandongadale/Rose R.	300	8224	671 266	10.5.79	24	AB
					1.4.80	27	AB
					22.2.89	8	K
27	Buffalo R.	280	8224	701 276	6.4.78	2	AB
					17.2.89	4	K
28	Buffalo R.	260	8224	705 370	20.2.89	1	K
29	Buffalo R.	240	8224	700 392	20.2.89	9	K
30	Stony Ck	300	8124	490 232	31.10.83	3	AS
31	King R.	480	8124	489 118	16.2.89	100	AB
32	King R.	380	8124	460 148	1.4.80	22	AB
33	King R. (West)	360	8124	428 192	15.12.79	26	AS
34	King R.	200	8124	482 466	7.4.78	22	AB
					30.3.80	10	AB
35	15 Mile Ck	580	8124	355 204	13.3.79	15	AB
36	15 Mile Ck	480	8124	355 253	18.3.89	2	*
37	Ryans Ck	340	8124	303 357	14.3.79	1	AB
38	Hollands Ck	360	8124	228 239	28.11.79	34	AB
					8.6.89	2	K
39	Delatite R.	420	8123	323 922	11.5.89	26	K
40	Delatite R.	380	8123	242 888	10.5.89	26	K
41	Delatite R.	380	8123	226 882	9.5.89	6	K
42	Delatite R.	320	8123	203868	3.5.89	1	K
43	Delatite R.	320	8123	165 857	5.5.89	1	K
44	Howqua R.	360	8123	299 794	18.4.78	1	AB
45	Jamieson R.	360	8123	265 725	18.4.78	3	AB
46	Goulburn R.	380	8123	302 621	19.4.78	4	AB
47	Royston R.	400	8023	990 684	2.5.89	4	*
48	Rubicon R.	360	8023	981 700	3.5.89	1	*
49	Acheron R.	400	8022	844 403	11.12.87	2	*

Site No.	Stream	Altitude (m)	Map. No.	Grid Ref.	Date	No. Specimens	Collector
50	Murrindindi R.	360	8023	725 600	27.6.89	1	*
51	Yea R.	360	7922	605 468	27.6.89	1	*
52	Kalatha Ck	240	7923	633 590	27.6.89	1	*
53	King Parrot Ck	360	7923	450 560	3.11.79	20	AS
					20.10.80	7	AS
					1.6.87	5	*
					5.5.89	22	*
54	King Parrot Ck	360	7923	455 563	26.10.78	2	PJ
55	King Parrot Ck	280	7923	483 658	11.10.78	5	PJ

Table 1. Sites sampled and details of collections made. AB = Baxter 1985, AS = Sanger 1984, BT = B. Tunbridge, GP = G. Paras (angling record), JK = Koehn 1987, K = Kaiela Fisheries Research Station, NMV = Museum of Victoria, PJ = P. Jackson, * = this study.

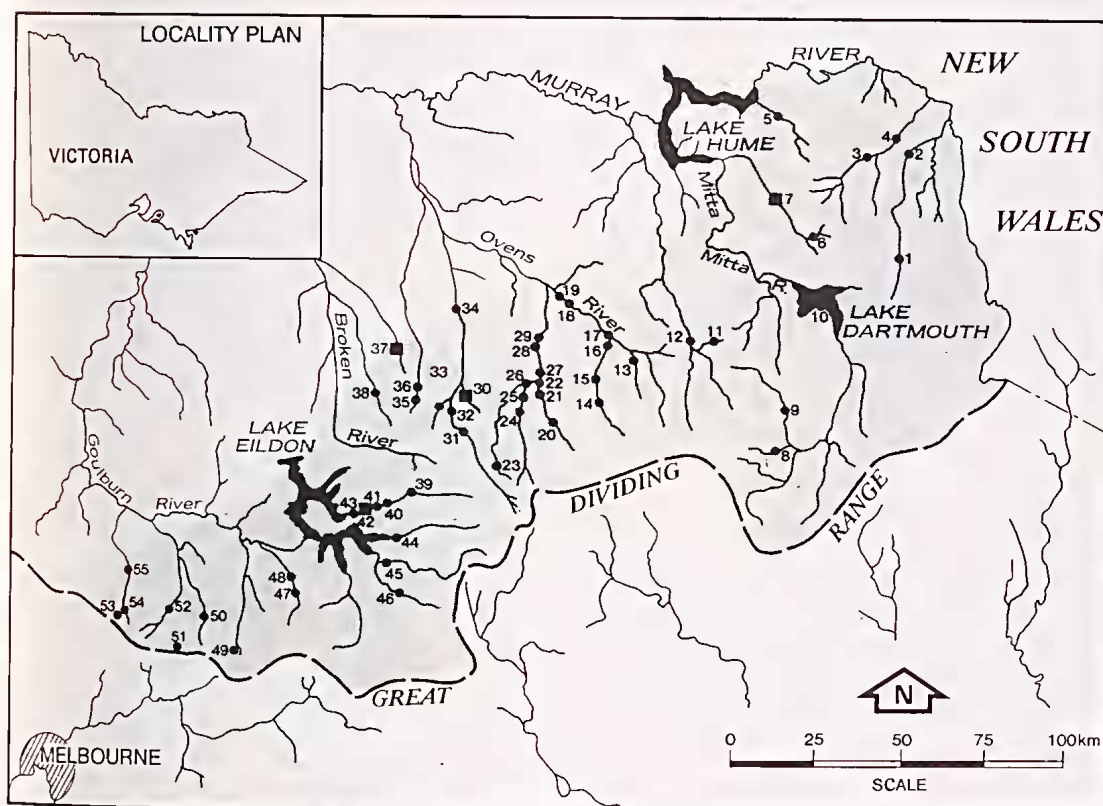


Fig. 1. Site localities and distribution of *Gadopsis bispinosus* in Victoria; squares indicate sites where *G. mar-moratus* occurs with *G. bispinosus*.

G. bispinosus has also been collected recently from the Cotter River in the Australian Capital Territory (Lintermans & Rutzu 1990), and the Australian Museum contains specimens from the Geehi River (Kosciusko National Park,

January 1975) and Micalong Creek (upstream of Wee Jasper, 1931) in New South Wales (T. Gill, Australian Museum, Sydney, pers. comm.).

All sites in Victoria are in the upper reaches of streams, but *G. bispinosus* was absent from sev-

eral headwater tributaries where cascades and very high water velocities were present. The specimens ranged in size from young-of-the-year fish with a total length of 45 mm (site 48) to 275 mm (site 47). Although sites were not sampled quantitatively, *G. bispinosus* was considered to be abundant at many of them. More than 50 specimens were collected at three sites and 20 or more specimens at 24 sites; in addition, Sanger (1990) collected a total of 1055 specimens from site 53 on King Parrot Creek between June 1980 and June 1982.

At sites for which records of other species were available, *G. bispinosus* was associated with brown trout, *Salmo trutta*, at 95% of sites; with rainbow trout, *Oncorhynchus mykiss*, at about 50% of sites; and with redfin, *Perca fluviatilis*, at about 50% of sites. Other species collected with *G. bispinosus* include Murray cod, *Maccullochella peelii*; trout cod, *M. uacuariensis*; *Galaxias* spp., particularly, *G. olidus*; Australian smelt, *Retropinna semoui*; southern pigmy perch, *Nannoperca australis*; and goldfish, *Carassius auratus*. *Gadopsis marmoratus* occurred in sympatry with *G. bispinosus* at sites 7, 30, 37, and 42 but was found without *G. bispinosus* in a small sample upstream of site 37. *G. marmoratus* was common at downstream localities along the northern and western edges of the range of *G. bispinosus*.

DISCUSSION

In Victoria, *G. bispinosus* is restricted to the upper reaches of streams in the north-eastern part of the state, in a band covering a maximum distance of about 100 km from the ridge of the Great Dividing Range (Fig. 1). The western limit of the range appears to be King Parrot Creek, about 50 km north-east of Melbourne. The northern and eastern parts of the species' range extend into New South Wales. The distribution in Victoria encompasses that previously suggested by Sanger (1986).

G. bispinosus is common and abundant throughout most of its range in Victoria and appears under no immediate threat. Consequently, despite the lack of historical population data, it is suggested that the conservation status of *G. bispinosus* in Victoria should be revised to the category of "restricted", in that it is a taxon which is "not presently in danger but which occurs in a restricted area" (Koehn & Morison 1990). This suggestion is consistent with the view of Sanger (1984) that *G. bispinosus* is not a rare or endangered species and should

not be afforded greater protection than *G. marmoratus*. The latter is a popular angling species in southern Victoria (Barnham 1983, Koehn 1984), but *G. bispinosus* is much smaller and is unlikely to be a major target species of anglers, although it may be caught incidentally.

Cadwallader et al. (1984) included *G. marmoratus* in Category E ("requiring careful monitoring in Victoria"), partly because the taxonomy of *Gadopsis* was under review. For the same reason, the recent conservation status review (Koehn & Morison 1990) included *G. marmoratus* in the equivalent category of "indeterminate".

Two distinct forms of *G. unarmatus* (southern and northern) have been referred to by recent workers (Ovendon et al. 1988, Sanger 1986) and these may be recognised as separate species in the future (Sanger pers. comm.). *G. marmoratus* (northern form) has been found with *G. bispinosus* at four of the sites sampled, and Sanger (1984) previously reported sympatry between these species in the upper King River. Although both species appear to have similar life history strategies, no evidence for interspecific hybrids has been found (Sanger 1984). Sanger (1986, 1990) found *G. bispinosus* to have an extended spawning period of November–February, similar to that of *G. marmoratus* (Jackson 1978a, Koehn unpubl. data). It is assumed that spawning sites of *G. bispinosus* are similar to those of *G. marmoratus*; that is, inside hollow logs (Jackson 1978a, Koehn unpubl. data) and possibly among rocks (Proebsting et al. 1974). Large numbers of *G. bispinosus* (including young-of-the-year-fish) have been collected amongst cobbles and boulders in stream reaches without wood debris and logs, and it is likely such areas may be used as spawning sites.

The distribution of *G. marmoratus* and *G. bispinosus* in northern streams appears to be related to the habit and habitat requirements of the two species. *G. marmoratus* is usually associated with instream cover, showing a preference for habitats where water velocities are low and logs and wood debris abundant (Jackson 1978a, 1978b, Koehn 1986). Such habitats tend to be in the lower, slower-flowing reaches of northern streams. *G. bispinosus* has mostly been found in clear streams with rocky bottoms where water velocities may be relatively high. The species was usually found to be utilizing some form of instream cover, often cobbles and boulders as wood debris was not always present. The species was not common in open water or in more

homogeneous substrates (Sanger 1990). Koehn (1987) found that boulders placed in the Ovens River markedly increased the numbers of *G. bispinosus* present because the boulders created a range of habitats that could be used as shelter from the fast water velocities. Being a smaller, more slightly built species than *G. marmoratus* (southern form), *G. bispinosus* appears to be able to utilize such instream niches more effectively. *G. bispinosus* was not found in the headwaters of many streams that, although providing sheltered areas, also contained areas of fast-flowing or cascading water.

Several other freshwater fish genera include two closely related species, one of them inhabiting the upper reaches of a river system and the other inhabiting the lower reaches. The Murray cod, *Maccullochella peelii*, inhabits the warmer, slower, lowland reaches of streams in the Murray-Darling River system, whereas the trout cod, *M. macquariensis*, is better adapted to cooler upland reaches (McDonald 1978, Cadwallader 1979, Cadwallader & Gooley 1984). The distributions of the golden perch, *Macquaria ambigua*, and the closely related Macquarie perch, *M. australasica*, show a similar relationship (McDonald 1978, Cadwallader 1979, 1981), as do the distributions of the flat-headed galaxias, *Galaxias rostratus*, and the Mountain galaxias, *G. olidus*, in the Murray-Darling River system (Cadwallader 1979, Cadwallader & Backhouse 1983).

Galaxias olidus was present at many of the Victorian localities surveyed and would be expected to occur throughout much of the range of *G. bispinosus*. The distribution and abundance of *G. olidus* has been severely reduced, however, by interactions with brown trout, *S. trutta*, and mutually exclusive populations of the two species have been documented (Tilzey 1976, Cadwallader 1979, Fletcher 1979, Jackson & Davies 1983, Jackson & Williams 1980, Koehn unpubl. data). Regular stocking of *S. trutta* by the Fisheries Division occurs throughout the range of *G. bispinosus* (Barnham 1989), and because the upper reaches of streams are particularly suited to both species, interaction between them may be expected to be more intense than between *G. marmoratus* and *S. trutta*. Sanger (1984) noted predation by *S. trutta* as a cause of mortality in *G. bispinosus* but reported that *G. bispinosus* remained abundant. Jackson (1978a, 1981) and Jackson & Williams (1980) considered that, although there was dietary overlap between *G. marmoratus* and

S. trutta, they avoided direct competition by occupying different habitats.

The sympatric relationship between *G. bispinosus* and *G. marmoratus* and the interaction of the former with *S. trutta* are worthy of further study. Further information is also needed on the habitat and spawning requirements of *G. bispinosus*, as environmental degradation such as sedimentation and habitat alteration are likely to pose the greatest threat to the species.

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REFERENCES

- ANDERSON, J. R. & MORISON, A. K., 1989. Environmental flow studies for the Wimmera River, Victoria. Part D. Fish populations — past, present and future. Conclusions and recommendations. Arthur Rylah Institute for Environmental Research Technical Report Series No. 76. Department of Conservation, Forests and Lands, Melbourne.
- BARNHAM, C., 1983. Report on the census of angling clubs 1983. Fisheries and Wildlife Division, Ministry for Conservation, Melbourne.
- BARNHAM, C., 1989. Summary of immediately available records of non-indigenous and indigenous fish stockings in Victorian public waters 1871 to 1988. Fisheries Information Report No. 2 (Draft), Freshwater Fish Management Branch, Fisheries Division, Department of Conservation, Forests and Lands, Melbourne.
- BAXTER, A. F., 1985. Trout Management Group fish population surveys, 1978–79; location of sampling sites and fish species caught. Arthur Rylah Institute for Environmental Research Techni-

- cal Report Series No. 15. Department of Conservation, Forests and Lands, Melbourne.
- BRUMLEY, A. R., MORISON, A. K. & ANDERSON, J. R., 1987. Revision of the conservation status of several species of warmwater native fish after surveys of selected sites in northern Victoria (1982-1984). Arthur Rylah Institute for Environmental Research Technical Report Series No. 33. Department of Conservation, Forests and Lands, Melbourne.
- CADWALLADER, P. L., 1979. Distribution of native and introduced fish in Seven Creeks River System, Victoria. *Australian Journal of Ecology* 4: 361-385.
- CADWALLADER, P. L., 1981. Past and present distributions and translocations of Macquarie perch *Macquaria australasica* (Pisces: Percichthyidae), with particular reference to Victoria. *Proceedings of the Royal Society of Victoria* 93: 23-30.
- CADWALLADER, P. L. & BACKHOUSE, G. N., 1983. *A Guide to the Freshwater Fish of Victoria*. Victorian Government Printing Office, Melbourne, 249 p.
- CADWALLADER, P. L. & GOOLEY, G. J., 1984. Past and present distributions and translocations of Murray cod *Maccullochella peelii* and trout cod *M. macquariensis* (Pisces: Percichthyidae) in Victoria. *Proceedings of the Royal Society of Victoria* 96: 33-43.
- CADWALLADER, P. L., BACKHOUSE, G. N., BEUMER, J. P. & JACKSON, P. D., 1984. The conservation status of the native freshwater fish of Victoria. *Victorian Naturalist* 101: 112-114.
- FLETCHER, A. R., 1979. Effects of *Salmo trutta* on *Galaxias olidus* and macroinvertebrates in stream communities. MSc thesis, Monash University, Clayton, Victoria.
- JACKSON, P. D., 1975. Bionomics of brown trout (*Salmo trutta* Linnaeus, 1758) in a Victorian stream with notes on interactions with native fishes. PhD thesis, Monash University, Clayton, Victoria.
- JACKSON, P. D., 1978a. Spawning and early development of the river blackfish *Gadopsis marmoratus* (Gadopsiformes: Gadopsidae) in the McKenzie River, Victoria. *Australian Journal of Marine and Freshwater Research* 29: 293-298.
- JACKSON, P. D., 1978b. Benthic invertebrate fauna and feeding relationships of brown trout, *Salmo trutta* Linnaeus, and river blackfish, *Gadopsis marmoratus* Richardson, in the Aberfeldy River, Victoria. *Australian Journal of Marine and Freshwater Research* 29: 725-742.
- JACKSON, P. D., 1981. Trout introduced into south-eastern Australia: their interaction with native fishes. *Victorian Naturalist* 98: 18-24.
- JACKSON, P. D. & DAVIES, J. N., 1983. Survey of the fish fauna in the Grampians region, south-western Victoria. *Proceedings of the Royal Society of Victoria* 95: 39-51.
- JACKSON, P. D. & LLEWELLYN, L. C., 1980. Family Gadopsidae: River Blackfish. In *Freshwater Fishes of South-Eastern Australia*, R. M. McDowall, ed., Reed Books, Sydney, 160-161.
- JACKSON, P. D. & WILLIAMS, W. D., 1980. Effects of brown trout, *Salmo trutta* Linnaeus, on the distribution of some native fishes in three areas of southern Victoria, Australia. *Australian Journal of Marine and Freshwater Research* 31: 61-67.
- KOEHN, J. D., 1984. Survey of angling and recreational use of the Gellibrand River, south-western Victoria. Arthur Rylah Institute for Environmental Research Technical Report Series No. 10. Department of Conservation, Forests and Lands, Melbourne.
- KOEHN, J. D., 1986. Approaches to determining flow and habitat requirements for native freshwater fish in Victoria. In *Stream Protection: the Management of Rivers for Instream Uses*, I. C. Campbell, ed., Water Studies Centre, Chisholm Institute of Technology, Melbourne, 95-115.
- KOEHN, J. D. 1987. Artificial habitat increases abundance of two-spined blackfish *Gadopsis bispinosus* in Ovens River, Victoria. Arthur Rylah Institute for Environmental Research Technical Report Series No. 56. Department of Conservation, Forests and Lands, Melbourne.
- KOEHN, J. D. & MORISON, A. K., 1990. A review of the conservation status of native freshwater fish in Victoria. *Victorian Naturalist* 106: 13-25.
- LINTERMANS, M. & RUTZOU T., 1990. A new locality for the two-spined blackfish (*Gadopsis bispinosus*) outside Victoria. *Victorian Naturalist* 106: 26-27.
- MCDONALD, C. M., 1978. Morphological and biochemical systematics of Australian freshwater and estuarine percichthyid fishes. *Australian Journal of Marine and Freshwater Research* 29: 667-98.
- MORISON, A. K. & ANDERSON, J. R., 1987. Status of trout cod *Maccullochella macquariensis*, Macquarie perch *Macquaria australasica*, and other fish populations in the upper reaches of Seven Creeks, based on surveys between 1981 and 1987. Arthur Rylah Institute for Environmental Research Technical Report Series No. 59. Department of Conservation, Forests and Lands, Melbourne.
- OVENDON, J. R., WHITE, R. W. G. & SANGER, A. C., 1988. Evolutionary relationships of *Gadopsis* spp. inferred from restriction enzyme analysis of their mitochondrial DNA. *Journal of Fish Biology* 32: 137-148.
- PROEBSTING H., HOCK, P. & STAUDE, H. 1974. *Gadopsis marmoratus* - the river blackfish. *Fishiales* 5(5): 12-14; 5(6): 7-8. Eastern Districts Aquarium Society, Victoria.
- SANGER, A. C., 1984. Description of a new species of *Gadopsis* (Pisces: Gadopsidae) from Victoria.

- Proceedings of the Royal Society of Victoria* 96: 93-97.
- SANGER, A. C., 1986. The evolution and ecology of *Gadopsis marmoratus* complex. PhD thesis, University of Melbourne.
- SANGER, A. C., 1990. Aspects of the life history of the two-spined blackfish, *Gadopsis bispinosus*, in King Parrot Creek, Victoria. *Proceedings of the Royal Society of Victoria* 102: 89-96.
- TILZEY, R. D. J., 1976. Observations on interactions between indigenous Galaxiidae and introduced Salmonidae in the Lake Eucumbene catchment, New South Wales. *Australian Journal of Marine and Freshwater Research* 27: 551-564.